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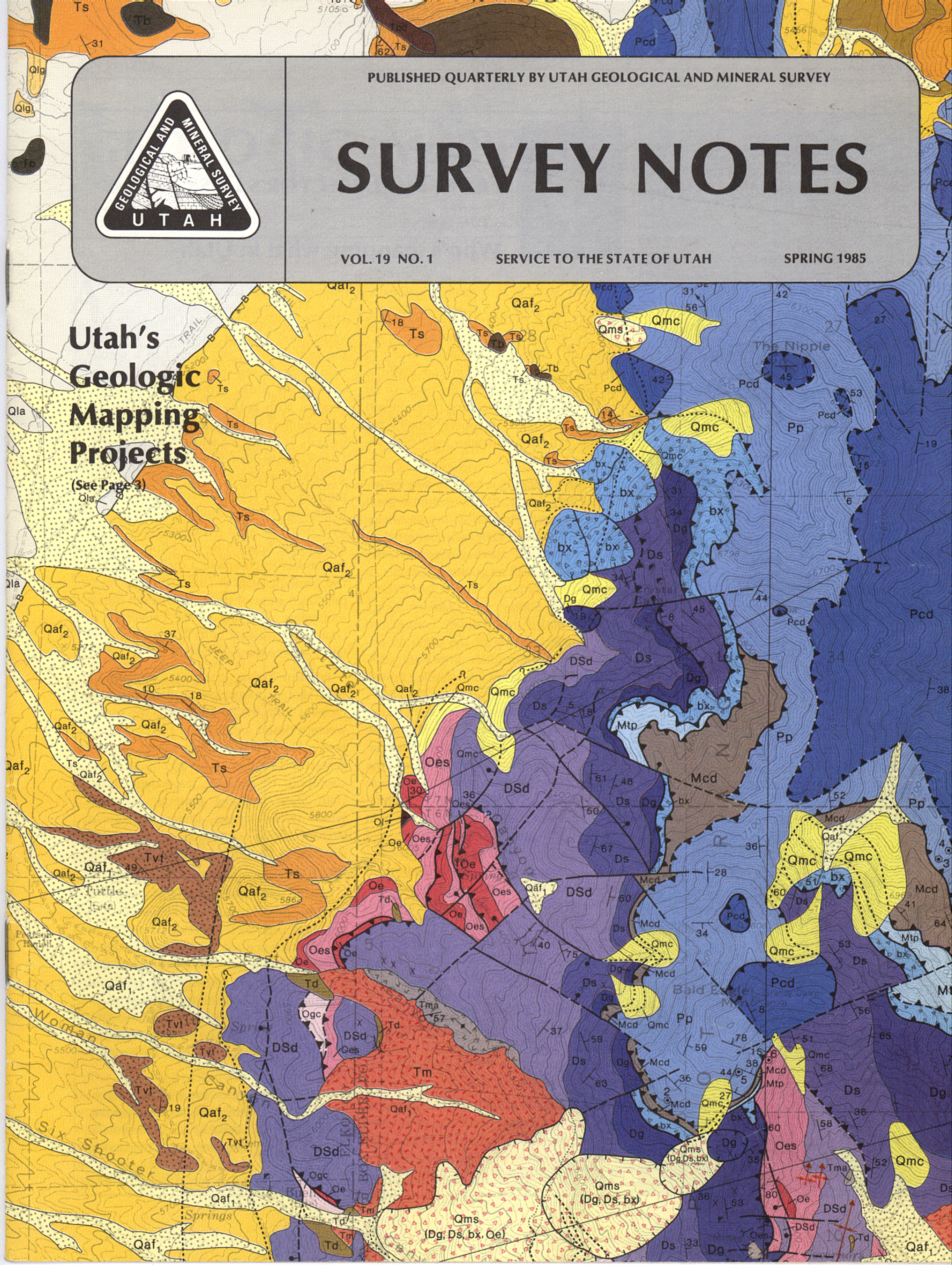
SURVEY NOTES

VOL. 19 NO. 1 SERVICE TO THE STATE OF UTAH SPRING 1985

Utah's Geologic Mapping Projects

(See Page 3)



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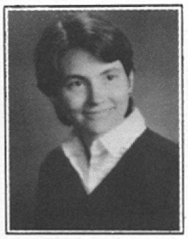

FROM THE DIRECTOR'S DESK

Who's mapping what in Utah

THIS ISSUE of Survey Notes highlights the geologic quadrangle mapping activities of UGMS and contains a listing of ongoing geologic projects in Utah. Hellmut Doelling's article describes the purpose for the UGMS geologic mapping program and each of the UGMS mappers' articles explains why their quadrangles are of high priority to the state.

Geologic mapping is hardly a new activity in Utah. Many of the nation's great geologists have tromped across and mapped Utah's terrain. Early work undertaken by governmental surveys identified the geographic as well as geologic features of the western territories. In the late 1860's, the Hayden Survey and Clarence King's with the 40th Parallel Survey contributed to the understanding of the Uinta Mountains and northern Utah. Important early mapping was done by John Wesley Powell along the Colorado River during the 1860's and 70's, G. K. Gilbert for his work in the Henry Mountains and the Lake Bonneville area during the 1870's, and Clarence Dutton in the High Plateaus during the 1860's - 1870's to name a few. Later, there was a period of mineral district mapping by USGS geologists. B. S. Butler's work in the early 1900's on ore deposits covered all of Utah. Other geologists who made important geologic maps include Emmons in the Mercur, Little Cottonwood, and the San Francisco district; Boutwell in the Park City district; Lindgren and Loughlin in the Tintic district; and Callaghan in the Marysvale district. These studies attracted industry to the state and helped explain the environments for the ore deposits. Hal Morris and Ed Tooker, both of the USGS, seem to be the last of the Federal government geologists who have spent literally decades understanding the intricacies of the geology of mining districts.

Universities also have turned their students to the problems of mapping Utah geology. After E.H. Spieker had spent much of his USGS career mapping and establishing the stratigraphy of the Wasatch Plateau (1920's-1930's), he joined Ohio State University and brought students to Utah. By the late 1940's, Ohio State had a regular field camp based in Ephraim and it continues there today. Other out-of-state universities such as the University of Missouri and Stanford have based their field camps in Utah, at least for a while. And, of course, Utah's universities have trained students by field camps and by geologic mapping projects. The University of Utah program guided by Armand Eardley produced maps over much of what is known today as the Thrust Belt. Spurred by the efforts of Wm. Lee Stokes to complete a major section of the geologic map of Utah, students mapped large areas of the northwestern desert mountains. Mapping at the University of Utah was probably in its heyday from the late 1940's to the early 1960's.

Brigham Young University, inspired by Lehi Hintze, expanded student mapping projects from the Provo area to the southwestern desert areas in the 1960's through today. The BYU field camp swings through central and southern Utah and the students contribute to geologic quadrangle maps. Utah State mapping projects, many of which were begun under J. Stewart Williams, have contributed to the understanding of the geology of Cache and Box Elder Counties.

For the early workers geologic mapping was the primary tool, and sometimes the only tool, used to solve geologic problems. As the science of geology developed, numerous other tools have become available to supplement geologic mapping and sometimes to substitute for geologic mapping on specific problems. However, geologic mapping continues to be the primary source of basic information on the geology of Utah.

That is all history . . . and it's only a partial listing of the contributors to the mapping of Utah geology. What I find exciting is the list of on-going mapping projects listed in

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UTAH'S GEOLOGIC MAPPING PROGRAM

By HELLMUT H. DOELLING

As THE U. S. Geological Survey topographic mapping program draws closer to completing all the 7 ½ minute quadrangles in Utah (completion date scheduled for 1989), most of us realize the great worth of the program. These maps are now "standard equipment" for planners, construction engineers, hydrologists, resource people, geologists, and others. If the geology of the state were now to be mapped systematically, these maps would also show their worth for a variety of purposes. Geologic maps have long been known to be useful for discovering and developing natural resources, such as metals, energy fuels, and groundwater, but we are now discovering their value in such areas as assessing geologic hazards sites, construction and waste disposal sites, military uses, and for land-use planning. Maps are one of the best means of making geological information available to potential users.

Geologic mapping has been going on ever since pioneer days, mostly by government agencies, universities, and resource companies and these institutions continue to do so as part of their various programs. This mapping was produced with varying degrees of accuracy, often with single uses in mind, and on presently unacceptable base maps. Certain areas were chosen for detailed, large-scale observations, others for small-scale regional uses, and some to solve a particular problem. Some areas of the state were adequately covered, others were neglected. Some of this mapping has been suitable for uses other than those for which it was produced, and many a geologist, engineer, or planner has been grateful that it was available. For the proper development of the state it must be available, making a systematic approach to the geologic mapping of the state essential.

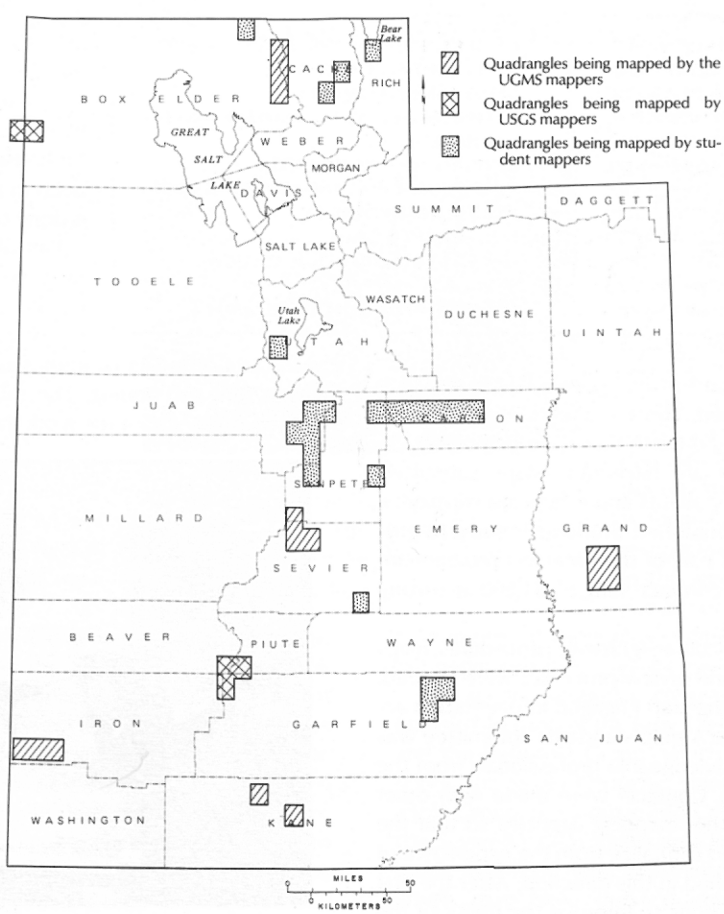
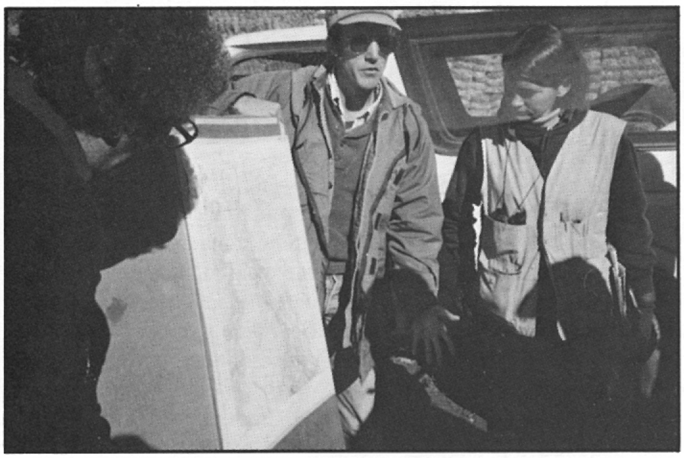


FIGURE 1. *Utah Geological and Mineral Survey Mapping Program Activity Map*

The need for a systematic geologic mapping program was recognized by the Utah legislature and a geologic mapping program was set up at the UGMS in July of 1983. The effort is not to be a "crash program", but to get the work done properly. It will take over 100 years to adequately map the 1512 quadrangles at the 1:24,000 scale standard. The program is initially designed to produce 10-15 geologic quadrangles annually. Three mappers have been hired, cooperative agreements have been set up with the U. S. Geological Survey, and contracts have been afforded students wishing to participate in the mapping of the state. Planning is underway to digitize the geologic mapping and store it in computers. Previous mapping was examined to see which was already adequate and to determine where new mapping was most urgently needed.

The legislative mandate to adequately map the state's geology led to a reorganization of the major UGMS programs. There are now three principal programs (omitting service-oriented programs) at the UGMS; Economic, Applied, and Mapping. The Mapping Program is not only responsible for the new 7½ minute geologic program, but also acquired the ongoing county mapping program. This county program was expanded to not only provide the geology and mineral inventory, but to provide a geologic hazards inventory of the county as well. The Geologic Mapping Program staff now consists of a senior geologist (Hellmut H. Doelling), three quadrangle mappers (Charles G. Oviatt, Mary A. Siders, Grant C. Willis), a regional mapper (Fitzhugh D. Davis), a digitizer-draftsperson (Deborah N. Jenkins) and a part-time geotechnician (Russell Knight).

7½ minute Quadrangle Mapping: UGMS mappers have been working hard since the inception of the program 18 months ago. The first 6 quadrangles assigned included Salina, Aurora, Pinon Point, Beryl Junction, Honeyville and Cutler Dam. Of these, Salina, Pinon Point, and Beryl Junction have been completed in the field and are presently undergoing extensive review, editing, and production work. The Honeyville quadrangle is nearly complete, being held up because of a need to recheck a small area of high mountain ground now covered with snow. Schedules indicate that field work for Honeyville, Aurora, and Cutler Dam will be completed this summer. New quadrangles already assigned include Brigham City, Redmond Canyon, and Mt. Escalante. Thereafter the UGMS staff geologists hope to complete five quadrangles annually. The UGMS has recently mapped the geology of Arches National Park (Map 74) at a scale of 1:50,000. During the course of the mapping four quadrangles were mapped at 1:24,000 scale standards. These will be produced as part of the 7½ minute series when the suitable topographic base maps become



FIGURES 2 and 3. *UGMS mappers put on a field review of nearly completed quadrangles, inviting interested parties for comment. Jack Oviatt talks about the Honeyville quadrangle. Above (left to right): Jack Oviatt; Lea Berry, Brigham Young University; Bruce Kaliser, Bill Lund, Utah Geological and Mineral Survey, and Jim McCalpin, Utah State University. In the photo on the left, (left to right): Bill Case, Jack Oviatt, and Genevieve Atwood (Director), Utah Geological and Mineral Survey.*

Utah Geological Map Standards Committee Members and Affiliations

GENEVIEVE ATWOOD	**UTAH GEOLOGICAL AND MINERAL SURVEY**
ROBERT BLAIR	**GETTY MINING COMPANY**
ROBERT P. BLANC	**GETTY MINING COMPANY**
HELLMUT H. DOELLING	**UTAH GEOLOGICAL AND MINERAL SURVEY**
DUANE HARRIS	**H.D. HARRIS, INC.**
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KENNETH A. SARGENT	**UNITED STATES GEOLOGICAL SURVEY**

available from the U. S. Geological Survey. Figure 1 illustrates which quadrangles will soon be published. Those produced by the UGMS mappers are filled in with black and those that were mapped by U. S. Geological Survey geologists are hachured. Maps submitted under contract to the UGMS by students and others are stippled, a few of these have already been published. Students wishing to produce a geologic map in Utah as part of their Masters program are invited to submit proposals. A contract sum of $1,500 is usually awarded to those who qualify.

Getting started has been a difficult assignment; procedures, mapping standards, proper formats, and review processes were needed. To begin with, the UGMS mapping staff engaged in orientation activities and standards discussions. A map standards committee was set up, enlisting the help of knowledgeable professionals from the USGS, universities, and industry. Contacts were made with other State Surveys, the USGS, and other mapping agencies so that the UGMS could avoid difficulties and capitalize from the experience of others. Work continues to be aimed in this direction. After the first maps are published, your suggestions to improve the utility of the maps will be welcomed.

The UGMS cartographic and editorial staff is now deeply involved in map production. Each map will be folded into an envelope and have an accompanying 8-16 page booklet. All the latest scribing techniques, peel-coat work, layout procedures, composite negative work, proofing and editing are carried out at the UGMS. A standard map will often require the production of 30 separate overlays, which are finally composited into five negatives for the printer. Doing this work "in-house" saves thousands of dollars in production work. Only the printing of the maps is done outside of the UGMS.

Part of the benefits of systematically mapping the state geologically are the unexpected discoveries or the increased understanding of the state's geology. The UGMS mapping staff consists of enthusiastic workers who are excited about what they are finding. The following are brief reports, written by the mappers, about the work they are doing.

FIGURE 4. *Members of the Utah Geological and Mineral Survey cartographic staff. From left to right: Pat Speranza, Jessie Roy, Kent Brown, and Jim Parker.*

PINON POINT, BERYL JUNCTION AND MT. ESCALANTE QUADRANGLES

By Mary A. Siders

THE PINON Point, Beryl Junction and Mount Escalante 7½ minute quadrangles are located in southwestern Iron County, on the southern edge of the Escalante Desert. These quadrangles lie within the Basin and Range Physiographic Province and have been included, along with adjacent areas in southeastern Nevada, in the "ignimbrite province" of the Great Basin (Mackin, 1960). This region consists of a thick veneer of Tertiary ash-flow tuff sheets and related rocks that overlie the pre-Tertiary basement complex. The style and volume of the explosive ash-flow tuff eruptions overshadow those of any historically documented volcanic eruption (Smith and Bailey, 1968). The 1980 eruption of Mount St. Helens, for instance, produced about one km^3 of ejecta. In contrast, estimated volumes for some of the prehistoric ash-flow tuff eruptions in the ignimbrite province are greater than 1,000 km^3.

It is partly the usefulness of ash-flow tuff sheets as "time lines" that makes them important objects of study. Unlike sedimentary formations, which may be deposited over a time span of millions of years, each ash-flow sheet is effectively geologically instantaneous over the entire range of its distribution. They can therefore provide distinctive marker beds that facilitate the unravelling of complex structural problems. The stratigraphic utility of ash-flow tuff sheets is enhanced by learning more about their vertical and lateral variability and by identifying a source region or caldera for each sheet.

The Pinon Point and Beryl Junction quadrangles contain mainly lava flows and domes of rhyolitic to basaltic composition, as well as a thick sequence of volcaniclastic rocks. In the Beryl Junction quadrangle, volcaniclastic rocks are host to silver mineralization that is exploited by the Escalante Silver Mine (Utah's largest primary silver mine). Whereas only limited outcrops of ash-flow tuff occur in the Beryl Junction and Pinon Point quadrangles, initial reconnaissance study of the Mount Escalante quadrangle has revealed large areal expanses of ash-flow tuff. Deposits of a young (Pliocene?) pyroclastic flow occur in the southwest portion of the Mount Escalante quadrangle, and the northern half of the quadrangle is covered by a thick sheet of the Racer Canyon or Hiko Tuff (Miocene). Continued field studies, petrographic studies and radiometric dating of these deposits are essential for a better understanding of the Cenozoic volcanic history of southwestern Utah.

Mackin, J.H., 1960, Structural significance of Tertiary volcanic rocks in southwestern Utah: American Journal of Science, v. 258, pp. 81-131.

Smith, R.L., and Bailey, R.A., 1968, Resurgent cauldrons: Geological Society of America Memoir 116, p. 613-662.

SALINA 7½ MINUTE QUADRANGLE

By Grant Willis

THE SALINA quadrangle, in Sevier County, is an area of unusually varied structural, stratigraphic, volcanic, hazards, and economic geologies. In fact lower Salina Canyon has been selected as one of the most important geologic localities in Utah by a committee of the Geological Society of America and will be included in a Decade of North American Geology commemorative volume. The most spectacular feature is a beautifully exposed unconformity in which horizontal early Tertiary beds overlie vertical Jurassic and Cretaceous beds (fig. 5). Equally important is the early and middle Tertiary stratigraphic section which may be the most complete in Utah.

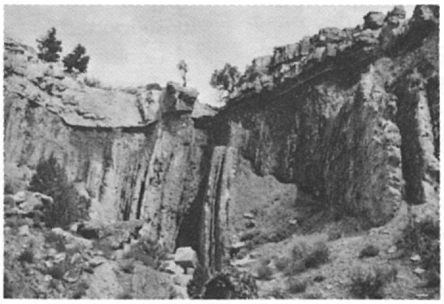


FIGURE 5. *Angular unconformity in lower Salina Canyon. Vertical beds are Jurassic Twist Gulch Formation. Horizontal beds are Eocene Flagstaff Formation.*

The quadrangle is influenced by several major geologic features. It is in the transition zone between the Colorado Plateau and the Basin and Range Physiographic Provinces and bears features of both. It is near the leading edge of the Sevier Orogenic belt and has rocks deformed by thrust-related folding and faulting. It sits astride the salt-bearing Arapien Shale depositional basin and is influenced by both evaporite diapirism and by salt dissolution and subsequent collapse of overlying rock. It has a large monoclinal fold similar to Laramide features. It is located in a basinal area between the Moroni-Tintic volcanic belt to the north and the Marysvale volcanic complex to the south and has rocks derived from both.

Exposed rocks occur in four main sequences separated by unconformities. These are: 1) Jurassic rocks which are at least 6000 feet thick, 2) about 3000 feet of exposed Cretaceous rocks (an additional 7000 feet of Cretaceous strata underlie the quadrangle), 3) up to 4500 feet of early Tertiary fluvial-lacustrine units, and 4) Oligocene through Miocene volcaniclastic and volcanic units which are about 1000 feet thick. Surficial deposits of several varieties also occur.

The Jurassic rocks are restricted shallow marine and tidal flat deposits. Salt was deposited as part of this sequence although the original amount is unknown due to subsequent flowage and dissolution. This salt is responsible for many unresolved questions in the area. Some workers attribute most if not all structural complexities in central Utah to diapirism of thousands of feet of salt while others say salt and salt-generated structures are minimal.

The second sequence consists of beds that are either the Late Jurassic Morrison or the Early Cretaceous Cedar Mountain Formation and the Indianola Group, which were deposited just prior to and during the Sevier Orogeny. Sometime after deposition of the Indianola Group, the Jurassic and Cretaceous rocks were forced up into the Sevier-Sanpete Valley anticline which has structural relief of as much as 20,000 feet. Most intensely deformed was the Arapien which may have been doubled or even tripled in apparent thickness. Workers have not yet resolved whether the anticline is a diapiric or a tectonic feature.

Continued on next Page

FIGURE 6. *View northward from Carter Peak approximately along trend of Sevier-Sanpete Valley anticline. Dark capping beds are Oligocene and Miocene ash flow tuffs deposited in a paleo-valley eroded into the light colored Arapien Shale. Steep west-dipping hogbacks of the Green River Formation are exposed along the left side of the volcanics. The Wasatch Monocline plunges westward in the upper right.*

Following a major period of erosion which levelled much of the area, early Tertiary fluvial-lacustrine rocks of the third sequence were deposited, forming the major unconformity seen today. The North Horn and Flagstaff Formations pinch out against a paleo-high centered over the anticline while the later Colton and Green River Formations thin over, but cover it. The last fluvial-lacustrine unit was the Bald Knoll Formation which varies from primarily sedimentary derived mudstone and sandstone in the lower part to mostly volcanic derived deposits in the upper. A pumiceous ash-flow tuff interbedded in the lower part was radiometrically dated at 40.5 ± 1.7 million years. Additional dating from ash near the top of the Bald Knoll yielded similar results. The dates indicate the tuff is too old to be derived from the nearby Marysvale volcanics and apparently came from the Moroni volcanics to the north. Later volcaniclastics rocks and volcanic tuffs of the fourth sequence were derived from Marysvale volcanics. Apparently the Salina area was a basin between the two volcanic belts and contains deposits from both.

Renewed movement occurred on the Sevier-Sanpete Valley anticline after deposition of the Bald Knoll and prior to about 25 m.y. B.P. It formed a narrow syncline in the Tertiary rocks on the east side, tilted similar strata steeply to the west on the west side, and exposed the Arapien in the center. Volcanic tuffs and volcaniclastic deposits 25 m.y. old and possibly as old as 34 m.y. were deposited in a valley eroded into the relatively soft Arapien (fig. 6). These volcanics are brecciated, faulted, and tilted, especially where they overlie the salt-bearing portion of the Arapien. Most of this deformation is attributed to dissolution of underlying salt and subsequent collapse of the overlying beds.

A major high-angle fault near Salina Canyon juxtaposes the Green River and Crazy Hollow Formations. Movement on the fault is down to the west but, in an interesting paradox, both sides appear to have downward drag (fig. 7). The paradox can be explained by the fault intersecting the axis of the aforementioned syncline. The fault and fold axes are inclined such that much of the zone of curvature is cut out, juxtaposing beds that dip in opposite directions. Typical fault drag has occurred, but not enough to change the original dip of the beds.

Earthquakes, flooding, and landslides present major geologic hazards in the Salina quadrangle. The landslide of greatest concern is located about three miles up the canyon from Salina and has, "tongue-in-cheek", been dubbed "Thistle-I" because of the similarity to the destructive 1983 landslide in Spanish Fork Canyon. Sediments deposited upstream from the slide show repeated episodes of movement, each of which dammed Salina Creek. The major episode, which occurred 6460 ± 60 years ago based on radiocarbon dating, formed a lake at least 150 feet and as much as 180 feet deep and 2 miles long. Fine-grained lake sediments up to 12 feet thick were deposited. Since that time the creek has cut down to near original base level, leaving the toe of the slide precariously unsupported.

FIGURE 7. *Fault by Salina Creek with paradoxical "downward drag" on both sides. The Crazy Hollow Fm. (right) is down against the Green River Fm. (left). The fault cuts out much of the zone of curvature of an asymmetrical syncline.*

Geologic resources in the quadrangle include gypsum, salt, lead and zinc, gravel, and possibly hydrocarbons. Gypsum is currently being mined from deposits in the Arapien Shale and processed into sheetrock wallboard. Salt has been quarried in the past. An abandoned lead and zinc mine exists in Salina Canyon in which carbonate cement in beds overlying the unconformity were replaced by primary minerals brought in by ascending solutions which moved up along underlying vertical beds. Drilling for liquid hydrocarbons has been attempted but no finds have been reported. ■

GEOLOGIC MAPPING IN THE HONEYVILLE QUADRANGLE

By C.G. Jack Oviatt

THE HONEYVILLE quadrangle is located along the northern Wasatch Range north of Brigham City. It contains excellent exposures of a thick sequence of Paleozoic marine rocks important in unraveling the geologic history of northern Utah. In addition, the quadrangle contains valuable sand, gravel, and limestone deposits, and potential geologic hazards including landslides and active fault zones. The area contains the highest peaks on the Wellsville Mountains — Wellsville Cone (9356 feet) and Box Elder Peak (9372 feet). It also covers part of the lower Bear River Valley on the west to an altitude of 4220 feet, and a small part of western Cache Valley in the northeastern corner of the map area. The Wellsville Mountains consist of a block of Paleozoic marine strata, part of the Cache allochthon or upper thrust plate, that is bounded on the east and west by late Tertiary and Quaternary normal faults. Thus, a wide variety of ancient and modern geologic environments are represented in the Honeyville quadrangle.

Over 14,000 feet of Paleozoic rocks in the Honeyville quadrangle range in age from Middle Cambrian to Late Pennsylvanian and possibly to Early Permian (fig. 8). These rocks consist of marine limestones, dolomites, shales, and sandstones. Fossils are abundant and have yielded valuable information on the ages and paleoenvironments of the rocks. Fossil collections include: Cambrian trilobites, Ordovician trilobites, cephalopods, graptolites, and corals, Silurian corals, Devonian fish plates, Mississippian crinoids,

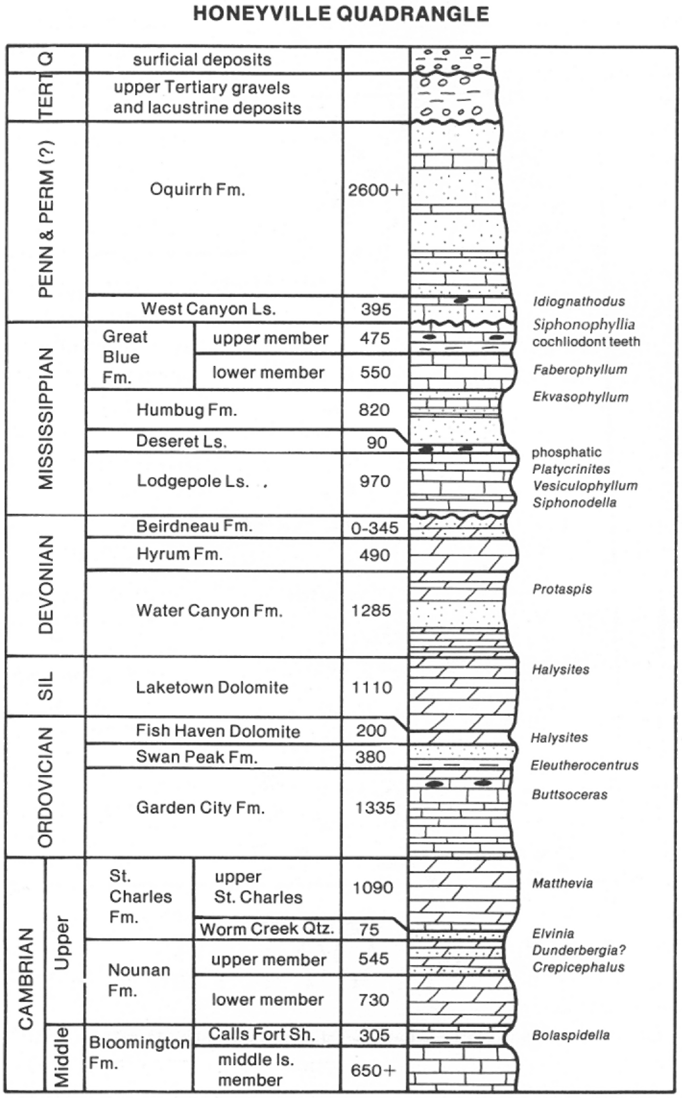


FIGURE 8. *Stratigraphic column for the Honeyville Quadrangle.*

corals, conodonts, fish teeth, and brachiopods, and Pennsylvanian fusulinids, corals, and bryozoans. Although unconformities are present in the section and some units are thin relative to their counterparts to the west in the Great Basin, the excellent exposures and relatively simple structures in the Wellsville Mountains offer valuable opportunities for Paleozoic stratigraphic analysis.

FIGURE 9. Platycrinites bozemanensis, *a Mississippian crinoid from the Lodgepole Limestone in the Honeyville quadrangle. Photo by Gary D. Webster.*

On the Wellsvilles the entire Paleozoic sequence is tilted approximately 30° to the northeast except at the north end of the mountain where the dips swing to the northwest around a steeply plunging anticline. A set of northeast-trending high-angle faults in the southern part of the area show evidence of strike-slip displacement and die out high in the section. They are probably tear faults related to Sevier Orogenic thrusting. Moderate-angle (35-50°), west-dipping normal faults apparently displace the tear faults and are probably related to late Tertiary and Quaternary (?) extension. The Wasatch and west Cache fault zones each show evidence in the quadrangle of probable late Quaternary movement.

Upper Tertiary gravels and fine-grained lacustrine beds, formerly referred to as the Salt Lake Group, cover an extensive area but are poorly exposed in the northern part of the quadrangle. Stratigraphic sections of Quaternary lacustrine beds deposited in Lake Bonneville and during a pre-Bonneville lake cycle are well exposed along the Bear River. Other important Quaternary deposits in the Honeyville quadrangle include avalanche debris in mountain canyons, glacial till in high mountain cirques, and stabilized landslide deposits along the mountain front. ■

FROM THE DIRECTOR'S DESK

Continued from Page 2

Martha Smith's article (which we know is only a partial listing) and our own UGMS work. Sometimes I'm asked why we need more geologic mapping when so much work has already been done. The easiest answer is to point out how most of the state has not been mapped at a detailed scale. But I also try to explain to lay people that the science of geology is evolving rapidly and that new geologic ideas can build on basic geologic data collected even a century ago. Charles Hunt built upon G. K. Gilbert's work in the Henry Mountains. The USGS mapping during the 1980's of the Richfield quadrangle built upon Callaghan's work of the 1930's. Today, Hellmut Doelling's UGMS work in Kane County uses C.D. Walcott's type sections for the stratigraphy of Kane County. Even when the entire concept to explain the geology of an area has totally changed, the geologists' basic observations are useful. An example is Crittenden's and Eardley's work in the northern Wasatch. Their terminology and stratigraphy are being used by UGMS mapping geologist Jack Oviatt. Mary Siders' UGMS quadrangle work in southwestern Utah is expanding work by the BYU program led by Myron Best. Grant Willis' UGMS Salina quadrangle will contribute basic information to help resolve conflicting theories for the structural history of the area.

And today's geologic mapping is only a reflection of present knowledge and technology. Years hence, geologists will build upon the work described in this issue of Survey Notes and gradually we will understand the fundamental principals of geology. All this helps us understand the resources and hazards of the state. ■

Genevieve Atwood

UTAH EARTHQUAKE ACTIVITY

October through December 1984

By WILLIAM D. RICHINS

UNIVERSITY OF UTAH SEISMOGRAPH STATIONS
DEPARTMENT OF GEOLOGY AND GEOPHYSICS

THE UNIVERSITY of Utah Seismograph Stations unit records a 75-station seismic network designed for local earthquake monitoring within Utah, southeast Idaho, and western Wyoming. During October 1 to December 31, 1984, 149 earthquakes were located within the Utah region.

The largest earthquake during this time period occurred on October 15, 1984, 22 km northwest of Tremonton. This earthquake had a magnitude of 3.4 and was felt in Howell and Portage. Two other earthquakes reported felt in the Utah region during this time period were shocks of magnitude 2.1 and 2.0 on November 25, 1984, located near, and felt at, St. George, Utah. Other significant aspects of earthquake activity during the report period shown in figure 1 include (from north to south):

1) clustered earthquakes (mag. 2.3) in southeastern Idaho northeast of Logan and 40 km north of the Utah-Idaho border;

2) clustered earthquakes (mag. 3.4) in the Utah-Idaho border area north of the Great Salt Lake;

3) small-magnitude earthquakes (mag. 1.8) southwest of Logan in the vicinity of the Wellsville Mts. during November and December;

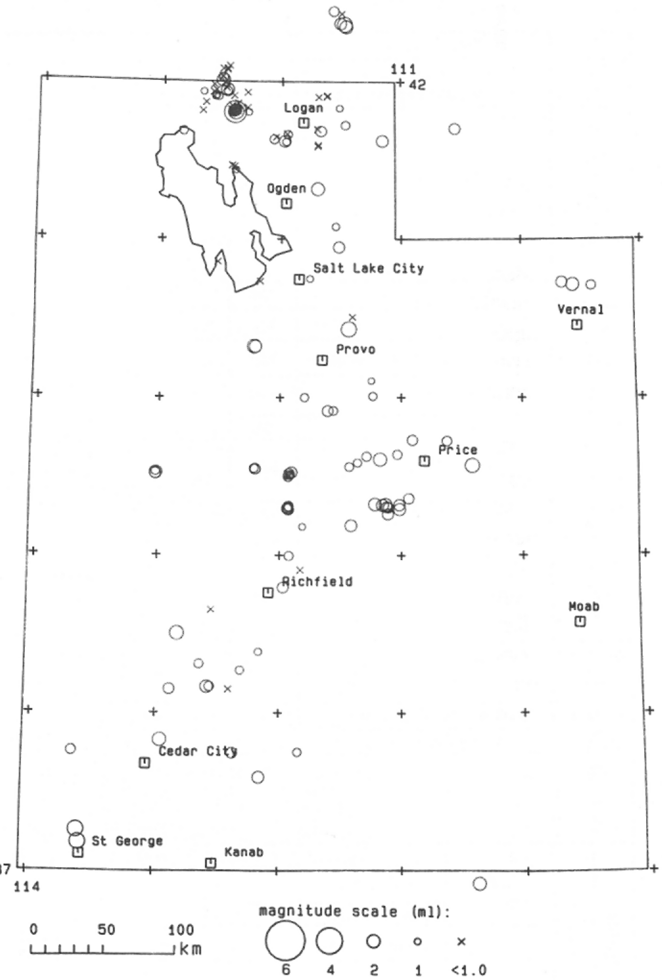
4) a magnitude 2.3 earthquake 30 km northeast of Provo near Wallsburg on December 16;

5) clustered small-magnitude earthquake activity in the vicinity of active underground coal mining west and southwest of Price in central Utah;

6) tightly clustered small earthquakes (mag. 2.0) in two localities in central Utah—within Juab Valley and the northern Sevier Valley;

7) scattered small earthquakes (mag. 2.1) throughout a broad belt between Cedar City and Richfield in southwest Utah.

(**Note:** Epicenters for small-magnitude seismic events north of Vernal and 50 km west of Provo are believed to represent local blasts.)



Utah Earthquakes: October 1 - December 31, 1984

Additional information on earthquake data within Utah is available from the University of Utah Seismograph Stations, Salt Lake City, Utah 84112 (801-581-6274). ■

PUBLICATION RELEASE

New UGMS Publication: Northern Wasatch Front Floods

Water Resources Bulletin 24, *Floods of May to June 1983 along the Northern Wasatch Front, Salt Lake City to north Ogden, Utah,* by K.L. Lindskov, 1984, 10 pages, maps and charts. $3.00 over-the-counter; add .17¢ for Utah State sales tax, and $2.00 for postage and handling. Prepayment is required.

Spring floods of eleven streams along the Northern Wasatch Front were monitored in 1983. Of these, nine had peak discharge that equalled or exceeded their 100-year flood levels. The flooding was the result of rapid late-spring melting of an abnormally large snowpack, enhanced by spring rains and unusually high temperatures. The streamflow remained high for days, weeks or months, and homes, highways and drainage systems were damaged as a result.

The purpose of this publication is to provide factual information to local, state, and federal officials to evaluate, coordinate, and manage programs relating to flood damage. The author, K.L. Lindskov, is a hydrologist with the Water Resources Division of the U.S. Geological Survey.

Please send ______ copies of Water Resources Bulletin 24 to:

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The Nonfuel Mineral Industry of Utah in 1984

Preliminary report, prepared by Lorraine B. Burgin, U.S. Bureau of Mines

THE VALUE OF nonfuel mineral production in Utah decreased from 1983's $656.6 million to $525.3 million in 1984, according to estimates by the Bureau of Mines, U.S. Department of the Interior. Metal production fell to less than two-thirds of the total value of nonfuel mineral output because of low metal prices and the corresponding drop in copper, gold, molybdenum, silver, and vanadium production.

Traditionally, copper is Utah's most important nonfuel mineral; however, in 1984, output plummeted as Kennecott, a subsidiary of Standard Oil Co. (Ohio), reduced production at its Utah Copper Division because of continuing losses and because its union representatives would not renegotiate its mid-1983 labor agreements. Management had sought reductions in wages, benefits, and cost-of-living adjustments. Beginning July 1, approximately 1,795 workers were gradually laid off. Kennecott, however, continued planning a billion-dollar modernization program. In November, the company and Anaconda Minerals Co., a subsidiary of Atlantic Richfield Co., announced a letter of understanding to jointly operate the mining and ore concentrating facilities of the Utah Copper Division, Salt Lake County, and Anaconda's idle Carr Fork unit, Tooele County. Kennecott would be the operator and receive 96% of the combined production, with each company retaining title to the reserves, properties, and assets placed under the operating agreement.

The steel industry remained depressed. At mid-year, open hearth operations at United States Steel Corp.'s Geneva Works near Orem were reduced from five to three or four furnaces, and Cedar City, UT, iron ore and Atlantic City, WY, taconite pellets were replaced with taconite pellets from Minnesota. The Desert Mound Mine at Cedar City was permanently closed. Atlas Corp., citing market conditions and cancellation of several nuclear power plants, shut down three uranium-vanadium mines and its Moab uranium-vanadium mill, laying off about 180 workers.

The total value of nonmetals production also declined because of decreases in the output of gypsum, lime, phosphate rock, potassium salts, and dimension stone. In descending order of value, the leading commodities in the group were estimated to be portland cement, salt, construction sand and gravel, gilsonite, lime, potassium salts, and phosphate rock. Great Salt Lake rose to 4,209.25 feet, its highest level since 1877, and industries on its shores continued to be severely affected. In May, Great Salt Lake Minerals & Chemicals Corp.'s solar evaporation ponds near Ogden were flooded to a depth of 4 to 6 feet by lake waters, thereby halting for at least a year the harvest of potassium sulfate by the nation's largest producer. Crushed stone production was increased to provide material to raise dikes to further protect the salt, magnesium, and potash industries, as well as roads and railroads from the rising lake waters.

ERRATA: *Vol. 18, No. 2 (Summer 1984)*

On Page 15 of the Utah Mineral Production Summary, 1983, the year-heading on Table 1 was transposed; the mineral production for 1982 has the incorrect heading of 1983p; that for 1983 has the incorrect heading for 1982. The mineral production data for 1983 shown in this issue has been updated and is slightly different from that shown in the Summer 1984 table.

TABLE 1. Nonfuel mineral production in Utah[1]

Mineral		1983 Quantity	1983 Value (thousands)	1984p Quantity	1984p Value (thousands)
Clays[2]	thousand short tons	227	$1,569	272	$2,053
Copper (recoverable content of ores, etc.)	metric tons	169,751	286,403	W	W
Gem stones		NA	80	NA	80
Gold (recoverable content of ores, etc.)	troy ounces	238,459	101,107	W	W
Gypsum	thousand short tons	305	2,736	339	2,780
Lead (recoverable content of ores, etc.)	metric tons	—	—	W	W
Lime	do.	315	16,771	312	16,536
Salt	do.	936	23,184	958	26,342
Sand and gravel:					
Construction	do.	e/9,800	e/19,800	10,400	21,500
Industrial	do.	24	W	—	—
Silver (recoverable content of ores, etc.)	thousand troy ounces	4,567	52,242	W	W
Stone:					
Crushed	thousand short tons	4,407	14,636	4,700	15,000
Dimension	do	W	W	—	—
Combined value of asphalt (native), beryllium concentrate, cement, clays (fuller's earth), iron ore (useable), magnesium compounds, molybdenum, perlite, phosphate rock, potassium salts, sodium sulfate, vanadium, zinc (1984), and values indicated by symbol W		XX	138,051	XX	440,963
TOTAL		**XX**	**656,579**	**XX**	**525,258**

e/ Estimated. p/ Preliminary. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure.

1/ Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

2/ Excludes fuller's earth, value included with "Combined value" figure. XX Not applicable.

GEOLOGIC PROJECTS IN UTAH

Conducted in Summer / 1984

In the spring of 1984 a request form was sent to each graduate school of geology in the United States, and also appeared in the Autumn 1983 issue of Survey Notes, asking for the location and a brief description of geologic mapping projects and other types of geologic studies planned for the summer of 1984 in Utah. Over 110 projects were reported, and computerized, and are listed below. Included in this information are: 1) principal investigator; 2) school or organization; 3) county(ies) in which work was done; 4) type of study; 5) specific geologic areas; and, 6) scale of mapping.

Thirty schools, institutions and agencies responded to the first questionnaire.

A new request form is included with this report for a description of projects planned for the summer of 1985. We would appreciate receiving your reply as soon as possible; this list will be printed in the fall of 1985, and the next will be in the spring of 1986 to provide information on geologic areas before the 1986 field season starts. If you need more forms, please let us know.

PROJECT NO.	GEOLOGIST/ INVESTIGATOR	ORGANIZATION	COUNTY (IES)	TYPE OF STUDY	LOCATION	SCALE OF MAP
1.	T E Jordan (et al.)	Cornell Univ. & USGS	Box Elder	geologic quads - 7 ½ min stratigraphy structural geology	Snowville, Salt Wells, Blind Springs, Lampo Junction Thatcher Mt., Howell quads	1:24,000
2.	R W Allmendinger & T E Jordan	Cornell Univ. & USGS	Box Elder	geologic map, stratigraphy structural geology	Bombing range	1:32,000
3.	D Miller & R Allmendinger	USGS - Menlo Park	Box Elder	geologic map, stratigraphy structural geology microstructural analysis	Crater Island quad	1:24,000
4.	R Allmendinger	Cornell Univ.	Tooele	geologic maps structural geology	Gold Hill area	1:24,000
5.	Allmendinger, Sharp, Van Tisch	Cornell Univ.	Millard	Cenozic - Mesozoic low-angle faults stratigraphy structural geology geophysics	West-Central Utah Line along 39° 15′ N	
6.	J Oliver & R Allmendinger	Cornell Univ., COCORP	Emery, Millard Sanpete	geophysics, reflective profile	Colorado Plateau - Western Nevada	
7.	T E Jordan	Cornell Univ.	Box Elder	stratigraphy, Penn-Perm	Oquirrh Basin	
8.	T E Jordan	Cornell Univ., USGS	Box Elder	stratigraphy, Penn-Permian facies, structural geology	Grouse Cr. Mts. Matlin Hills	1:38,000
9.	D M Saunders	Colorado State Univ.	Summit, Wasatch	mineralogic, Pb-Zn-Ag	Park City area, underground maps	
10.	Roger S Lowe	New Mexico Tech	San Juan	depositional environment	Morrison Fm., Montezuma Cn.	
11.	Russel L Wheeler	USGS	Juab Sanpete, Utah	earthquake hazards detailed map, reconnaissance	Central Utah	1:100,000
12.	John D Garr, J McCalpin	Utah State Univ.	Box Elder	Quaternary geology, neotectonics	Pocatello Valley, UT - ID	1:24,000
13.	Michael V Lowe,	Utah State Univ.	Cache	surficial geology	Smithfield quad	1:24,000
14.	James McCalpin	Utah State Univ.	Box Elder	Quaternary geology earthquake potential	Hansel Valley	1:50,000
15.	Anne Erdmann	Univ. of Minnesota	Morgan, Rich Salt Lake, Summit Utah, Wasatch	structural geology paleomagnetism	North Central Utah	
16.	Ivan D Sanderson	Purdue Univ.	Daggett, Duchesne Summit, Uintah Wasatch	Petrography	Hades Pass Fm. Uinta Mtns.	
17.	Ivan D. Sanderson	Purdue Univ.	Duchesne Summit Wasatch	petrology, stratigraphy	Red Castle Fm. Uinta Mtns.	1:24,000
18.	Donald W Fiesinger	Utah State Univ.	Box Elder	geochemistry, geologic mapping	Tertiary volcanics	
19.	Donald W Fiesinger	Utah State Univ.	Rich	geochemistry, geologic mapping, petrology	Black Mt. area	
20.	Donald W Fiesinger	Utah State Univ.	Box Elder	geochemistry, geologic mapping, petrology	Rhyolite Mts.	1:12,000
21.	David L Clark	Univ. of Wisconsin	Beaver, Box Elder Duchesne, Millard Rich, Salt Lake Summit, Uintah Utah, Wasatch	paleontology, conodont studies		
22.	R LaRell Nielson	Stephen F. Austin Univ.	Iron Kane Utah Washington	paleontology stratigraphy, depositional envirn., structural geology, Quaternary geology		
23.	J W Collinson, P Schwans	Ohio State Univ.	Juab Millard Sanpete	petrology, paleontology, stratigraphy, areal geology, maps, structural geology, Meso-Ceno conglomerates		
24.	W Britt Leatham & K Grinvalds	Ohio State Univ.	Cache Millard, Tooele	petrology, paleontology, conodont studies, stratigraphy	Ordovician - Silurian	
25.	G D Webster	Wash. State Univ	Juab Millard Tooele, Utah	paleontology, stratigraphy, Carboniferous	Soldier Canyon, Lake Mtn. Granite Mtn., Skunk Spring Burbank Hills	
26.	Sheldon K Grant	Univ. of Missouri-Rolla	Iron Washington	areal geology, maps		1:24,000

PROJECT NO.	GEOLOGIST/ INVESTIGATOR	ORGANIZATION	COUNTY (IES)	TYPE OF STUDY	LOCATION	SCALE OF MAP
27.	Sheldon K Grant	Univ. of Missouri-Rolla	Iron	stratigraphy areal geology, maps, structural geology		1:24,000
28.	R A Paull	Univ. of Wisconsin Milwaukee	Beaver, Box Elder Iron, Millard, Tooele	paleontology stratigraphy	Lower Triassic Rocks	
29.	I D Sanderson & A E DeGraff	Purdue Univ.	Duchesne Summit Wasatch	petrology stratigraphy, correlation	Precambrian Uinta Mt Group	
30.	I D Sanderson & K T Stephens	Purdue Univ.	Emery	stratigraphy, petrology structural geology	Navajo S.S. soft sediment deform.	1:5,000
31.	I D Sanderson & M T Wiley	Purdue Univ.	Daggett	petrology stratigraphy	basal Uinta Mt Group conq.	1:24,000
32.	Richard Van Horn	U.S.G.S.	Davis, Morgan Salt Lake	geologic mapping	Ft. Douglas quad	1:24,000
33.	David J Varnes	U.S.G.S.	Millard	geologic mapping	Oak City quad	1:31,680
34.	Nolan R Jensen	Brigham Young Univ.	Sanpete	geologic mapping structural geology environmental geology	Fairview quad	1:24,000
35.	Mike Russon	Brigham Young Univ.	Carbon	paleontology stratigraphy geologic map economic geology	Helper quad Castlegate NE	1:24,000
36.	John Jenson	Brigham Young Univ.	Washington	stratigraphy paleoenvironment		
37.	J Keith Rigby & Cathy Ball	Brigham Young Univ.	Millard	paleontology stratigraphy	Middle Cambrian, House Range	
38.	J Keith Rigby	Brigham Young Univ.	Emery Sevier	stratigraphy Permian-Cretaceous paleoecology	DNAG site	
39.	J Keith Rigby	Brigham Young Univ.	Garfield, Wayne	stratigraphy	Jurassic, Waterpocket Fold	
40.	Michael R. LeBaron	New Mexico Tech.	San Juan	stratigraphy, depositional environment	Morrison Fm., Montezuma Cn.	
41.	Lisa M Shorb	Duke Univ.	Washington	petrology stratigraphy	Motoqua quads , Moenkopi Fm. Scarecrow Peak, Dodge Spring	
42.	Kelly Norton	Northern Illinois Univ.	Sanpete Sevier	petrology stratigraphy	Crazy Hollow Fm.	
43.	Michael Roche	Northern Illinois Univ.	Sanpete	stratigraphy	Twist Gulch-Morrison-Indianola Fms.	
44.	Malcolm P Weiss	U.S.G.S.	Carbon Duchesne, Uintah	geologic mapping	Price quad	1:100,000
45.	Malcolm P Weiss	U.S.G.S.	Juab Sanpete	geologic mapping	Gunnison Plateau	1:100,000 1:250,000
46.	Elizabeth L Miller	Stanford Univ.	Juab	geologic mapping structural geology	Trout Creek quad	1:24,000
47.	Nicholas Christie-Blick	Lamont-Doherty Inst.	Juab, Utah Salt Lake, Weber Tooele	geochemistry, petrology paleontology, stratigraphy geologic mapping, structural	West Tintic, Alta, Fremont Is.	1:24,000
48.	J A Borkland & D Hodge	State Univ. of NY	San Juan	geology map, structural geology, geophysics	Polar Mesa	1:15,625
49.	Brendon Murphy	Bryn Mawr College	Box Elder	stratigraphy, geologic map	Limekiln Knoll quad	1:24,000
50.	Bart J Kowallis	Brigham Young Univ.	Salt Lake, Uintah Utah, Wayne	stratigraphy, structural geo- ology, fission track studies	Little Ctnwd. stock, Uinta Mtns., Jurassic-Cretaceous, Wtrpkt. Fd.	
51.	John Ehleiter	Westchester Univ.	Emery	paleontology	Wilsonville SE quad	1:24,000
52.	Mario V Caputo	Univ. of Cincinnati	Garfield Kane	stratigraphy, sedimentology historical geology, paleoecology		
53.	Paul Dean Proctor	Brigham Young Univ.	Iron Utah Washington	economic geology	Allens Ranch, Soldier Pass Antelope Peak, Silver Peak Silver Reef quads	1:24,000
54.	Edwin W Tooker	U.S.G.S.	Salt Lake Tooele Utah	paleontology, general stratigraphy, geologic mapping structural geology, economic geology	Oquirrh Mts.	1:24,000
55.	James L Baer	Brigham Young Univ.	Juab Sanpete	stratigraphy geologic map, structural geology	Skinner Lakes, Chriss Canyon Hells Kitchen SE, SW, Hayes Canyon, Gunnison quads	1:24,000
56.	Peter Schwans	Ohio State Univ.	Carbon, Emery Sanpete, Sevier	petrology, sedimentology stratigraphy, geologic map		
57.	David W. Rodgers	Stanford Univ.	Juab	petrology, metamorphic geologic map, structural geology	S. Deep Creek Range	1:24,000
58.	W.B. Cashion	U.S.G.S.	Uintah	stratigraphy oil shale, tar sands areal geology, structural geology	Bonanza, Nutters Hole SE quads	1:24,000
59.	Fred Peterson	U.S.G.S.	Garfield	stratigraphy, sedimentology	Kaiparowits Basin	
60.	Fred Peterson	U.S.G.S.	Emery Garfield Wayne	geochemistry, stratigraphy economic geology, uranium, coal, base & precious metals	Henry Mts.	
61.	Ronald C. Johnson	U.S.G.S.	Carbon, Emery Garfield, Grand Kane, San Juan	stratigraphy, Eocene structural geology	Uinta Basin	1:250,000
62.	Fred Peterson	U.S.G.S.	Carbon, Emery Garfield, Grand Kane, San Juan Wayne	stratigraphy, sedimentology structural geology, economic geology, uranium, geotectonics	Colorado Plateau Upper Jurassic Morrison Fm.	
63.	Russell F. Dubiel	U.S.G.S.	Carbon, Emery Garfield, Grand Kane, San Juan Wayne	stratigraphy, sedimentology economic geology, uranium	Colorado Plateau Upper Jurassic Chinle Fm.	
64.	Richard W. Scott, Jr.	U.S.G.S.	Carbon Duchesne Grand Uintah	stratigraphy, geologic map tar sand, oil shale, saline	Uinta Basin, Dragon, Wolf Point quads, Green River Fm.	1:24,000

PROJECT NO.	GEOLOGIST/ INVESTIGATOR	ORGANIZATION	COUNTY (IES)	TYPE OF STUDY	LOCATION	SCALE OF MAP
65.	Vito Nuccio	U.S.G.S.	Carbon, Daggett Duchesne, Emery Grand, San Juan Sanpete, Summit Uintah, Utah Wayne	geochemistry, thermal maturity, petroleum generation	Uinta Basin, Colorado Plateau, No. Rockies	
66.	Omer B. Raup	U.S.G.S.	Grand San Juan	mineralogy, geochemistry petrology economic geology, potash marine evaporites	Paradox Basin	
67.	George F. (Pete) Dana	Western Research Inst.	Garfield Wayne	tar sand mineralogy, geochemistry petrology, sedimentary stratigraphy, structural geology	Tar Sand Triangle	
68.	Mario V. Caputo	Univ. of Cincinnati	Emery, Garfield Grand, Iron Kane, Piute San Juan Washington Wayne	sedimentology, facies mapping	Colorado Plateau	1:5,000,000
69.	Mario V. Caputo	Univ. of Cincinnati	Garfield, Kane	sedimentology, Jurassic		
70.	Mario V. Caputo	Univ. of Cincinnati	Emery, Garfield Grand, Kane Wayne	stratigraphy, sedimentology	Summerville, Curtis Fms.	
71.	Andrew G. Raby	New Mexico Tech	Grand	petrology, paleontology stratigraphy, paleoenvironments,	Salt Wash, Morrison Fm.	
72.	Suzanne L. Sexsmith	New Mexico Tech	Emery Grand	paleontology stratigraphy, paleoenvironments	Salt Wash, Morrison Fm.	
73.	James Russell Dyer	U.Texas El Paso	Grand	areal geology structural geology	Arches Nat. Mon., Paradox Basin	1:24,000
74.	R.A. Robison	Univ. of Kansas		paleontology, stratigraphy	Cambrian, Great Basin	
75.	T Sullivan, A Nelson, S Nelson, L Foley	U.S. Bureau of Reclamation		areal geology,quat-ernary geology, maps and charts, seismotectonics	Cambrian	
76.	R.H. Dott, Jr.	U of Wisc., Madison	Box Elder, Davis Daggett, Morgan Salt Lake, Summit Tooele, Utah Wasatch, Weber	stratigraphy, sedimentology	Pennsylvanian, Uinta Mts., Oquirrh Basin	
77.	Linda B. McCollum	Eastern Wash. Univ.	Box Elder Weber	paleontology, stratigraphy stratigraphy, geologic mapping paleogeography	Cambrian, Great Basin S. Promontory Mtns.	1:24,000
78.	John E. Marzolf	So. Illinois Univ.		stratigraphy	Early Mesozoic	
79.	William M. Shorb	Duke Univ.	Washington	stratigraphy depositional environment	Motoqua quad., Scarecrow Peak quad., Dodge Spring quad., Moenkopi Fm.	
80.	M E Nelson, S Conley	Ft. Hayes State Univ.	Emery	mineralogy petrology, sedimentary stratigraphy areal geology, maps and charts	Buckhorn Conglomerate, Colorado Plateau	
81.	M E Nelson, J H Madsen	Ft. Hayes State Univ.	Juab Tooele	paleontology, general	T4-12S, 19W, Deep Creek Valley	
82.	M E Nelson, J H Madsen,	Ft. Hayes State Univ.	Tooele	paleontology, stratigraphy	4S-10W, S. Cedar Mtns.	
83.	M E Nelson, J H Madsen, W L Stokes	Ft. Hayes State Univ.	Salt Lake Utah	paleontology, mammels	Jordan Narrows	
84.	M E Nelson, J H Madsen, (et al.)	Ft. Hayes State Univ.	Emery	paleontology, vertebrate	Cedar Mt. Fm.	
85.	M E Nelson, D Crooks	Ft. Hayes State Univ.	Emery	stratigraphy, areal geology maps and charts	Cedar Mt. Fm.	
86.	M E Nelson, J H Madsen	Ft. Hayes State Univ.	Cache, Davis Morgan, Salt Lake Utah, Weber	paleontology, mammals	Lake Bonneville sands & gravels	
87.	Donna J. Sinks	Western Research Inst.	Grand Uintah	mineralogy stratigraphy structural geology engineering and environmental geology, geo-chemistry, lithology, tar sand	P.R. Spring	
88.	I. D. Sanderson	Purdue Univ. field camp		geologic mapping structure, stratigraphy	Beaver Dam Mts., St. George area, Virgin Anticline Zion National Park Hurricane Fault Bryce Canyon Nat'l Park Gunlock, Motoqua quads	
89.	R C Blakey	Univ. Northern Arizona	Emery, Garfield Grand, Kane San Juan Washington Wayne	stratigraphy	Late Paleozoic-Mesozoic Colorado Plateau (MS theses)	
90.	W P Nash	Univ. of Utah	Box Elder, Juab Millard, Beaver	volcanology, geo-chemistry, petrology	Great Basin	
91.	W P Nash	Univ. of Utah	Juab	volcanology, geo-chemistry, petrology mineralogy	Central Juab Co.	
92.	M D Bradley	Univ. of Utah	Summit	structural geology geologic mapping	Uinta Arch Overthrust Belt	1:24,000
93.	S Nelson	Brigham Young Univ.	Sevier	geologic mapping	Geyser Pk quad	1:24,000
94.	J McDermott	N. Illinois Univ.	Juab	geologic mapping	Chriss Corner	1:24,000
95.	D Clark	N. Illinois Univ.	Juab	geologic mapping	Juab quad	1:24,000
96.	R Bick	N. Illinois Univ.	Juab	geologic mapping	Nephi quad	1:24,000
97.	R Banks	N. Illinois Univ.	Juab	geologic mapping	Sugarloaf quad	1:24,000
98.	W Auby	N. Illinois Univ.	Juab	geologic mapping	Levan quad	1:24,000
99.	H Doelling, F. Davis	UGMS	Kane	geologic mapping	Rainbow Pt.	1:24,000

PROJECT NO.	GEOLOGIST/ INVESTIGATOR	ORGANIZATION	COUNTY (IES)	TYPE OF STUDY	LOCATION	SCALE OF MAP
100.	J Oviatt	UGMS	Cache, Box Elder	geologic mapping	Cutler Dam quad, Honeyville quad	1:24,000
101.	M Siders	UGMS	Iron	geologic mapping	Beryl Junct. quad, Pinon Pt. quad, Mt. Escalante quad	1:24,000
102.	G Willis	UGMS	Sevier	geologic mapping	Salina quad, Aurora quad, Redmond Cany. quad	1:24,000
103.	H Doelling	UGMS	Kane	geologic mapping	Windows Sec., Mollie Hogans, Klondike Bluffs, Merrimac Buttes	1:24,000
104.	J Anderson	USGS	Piute, Garfield Beaver	geologic mapping	Circleville quad, Circleville Mtn. quad, Fremont Pass	1:24,000
105.	L Berry	Brigham Young Univ.	Cache	geologic mapping	Porcupine Res quad	1:24,000
106.	S Mattox	N. Illinois Univ.	Sanpete	geologic mapping	Hells Kitchen quad	1:24,000
107.	P Proctor	Brigham Young Univ.	Utah	geologic mapping	Allens Ranch quad	1:24,000
108.	Murphy, Beus, J. Oviatt	Bryn Mawr, NAU-UGMS	Box Elder	geologic mapping	Limekiln Knoll quad	1:24,000
109.	D Kamola	Univ. of Utah	Garfield, Wayne	sedimentology, stratigraphy, Perm-Triassic	Capital Reef, Circle Cliffs	1:24,000
110.	M Chan	Univ. of Utah	Carbon, Emery Grand, Wayne, Garfield	sedimentology tectonics, cretaceous	Book Cliffs Colorado Plateau	1:24,000
111.	J R Bowman	Univ. of Utah	Salt Lake, Beaver	petrology, stable isotope geochemistry, Econ geol. - copper	Alta Rocky Range	1:24,000
112.	J E Huntoon	Univ. of Utah	Wayne, Garfield	sedimentology	Canyonlands	1:24,000
113.	B Shea	Univ. of Utah	Box Elder	geochemistry, mineralogy petrology	Wild Cat Hills	1:24,000
114.	S Morrison	Univ. of Utah	Emery, Grand San Juan	geochemistry, mineralogy petrology, Econ. geol.-copper	Colorado Plateau	1:24,000
115.	K Vygur	Univ. of Utah		sedimentology, petrology Econ. geology-petroleum	Colorado Plateau Northern Rockies	1:24,000
116.	D Wachtell	Univ. of Utah	Juab, Sanpete, Utah	Econ. geol-copper, silver, uranium, chemistry, mineralogy, petrology	High Plateaus Northern Rockies	

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Note: Location maps to the geologic projects are available at the UGMS, 606 Black Hawk Way, Salt Lake City, Utah 84108. ■

Status of Applied Geology Program

By DON M. MABEY

THE ASPECT of the UGMS Applied Geology Program that receives the most public attention concerns geologic events that are causing serious immediate problems. The primary objective of the program, however, is not reaction to distructive events but action designed to avoid such events and minimize the losses when they occur. The UGMS attempts to do this in three primary ways: (1) mapping of geologic hazards, (2) researching to provide improved understanding of the hazards, and (3) assisting local governments and state agencies to implement hazard reduction measures.

Events of the last two years have made decision makers and the public increasingly aware of the geologic hazards in Utah and have presented the UGMS with an opportunity to advance the state's geologic hazards reduction programs. Coinciding with this increased awareness is a greater emphasis by the U.S. Geological Survey on geologic hazard research in Utah, thus providing important funding support to the UGMS. The total effect has been a major increase in the UGMS program of hazards reduction. Within the last year the UGMS has received grants from the USGS to support (1) a Wasatch Front earthquake hazards reduction program, (2) landslide studies, and (3) employment of three hazards geologists employed to work in Wasatch Front counties. The total annual funding level of these programs is $420,000. The Utah legislature has approved adding two hazards geologists to the UGMS staff to work on a state-wide compilation of geologic hazards information. With this major increase in support for geologic hazards investigations, the UGMS has the opportunity to develop the information base. This data is necessary for determining actions to provide protection from geologic hazards.

At the same time that the new efforts to obtain basic information of gelogic hazards has been developing, the requests for assistance by local governments and other state agencies to handle immediate geologic problems have greatly increased. Bruce Kaliser, State Hazards Geologist, is assisting numerous groups that are experiencing or are threatened by geologic events. One important concern of the Senior Geologist for Applied Geology is to provide geologic input on problems relating to the rise of the Great Salt Lake. The Site Investigation Section is working throughout the state on engineering geology investigations in support of the activities of local government and state agencies. Although the demands placed on the Applied Geology Program are severely taxing the capacity of the staff, the opportunity to make major advances in reducing Utah's geologic hazards is very welcome. ■

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UGMS STAFF CHANGES

The following staff changes have taken place since last issue:

Klaus Gurgel, UGMS editor, resigned in November, 1984; he had been with the Survey three years. Under his direction the editorial unit achieved a high degree of excellence which resulted in several beautiful maps.

James Stringfellow, formerly editor at the Earth Science Laboratory, University of Utah Research Institute, is now the new UGMS editor.

In addition, the UGMS has established a new classification of expert geologist for individuals with advanced skills and experience. The first geologist to receive this classification is **Bruce N. Kaliser**. In this new position he will have title of State Hazard Geologist. ■

NEW PUBLICATIONS

GEOTHERMAL STUDIES

The following low-temperature geothermal investigations have just been released by the Utah Geological and Mineral Survey:

R.I. No. 191 - *Evaluation of low-temperature geothermal potential in Utah and Goshen Valleys and adjacent areas, Utah, Part II, water temperature and chemistry, 1984*, by Robert H. Klauk and Deborah Ann Davis. 45 pages, 2 plates, tables. (Sequel to R.I. No. 179, Gravity Survey, by Deborah Ann Davis and Kenneth Cook, 1983).

Five areas in Utah County have been identified as worthy of further investigation as a low-temperature geothermal resource. These areas, which include Saratoga Hot Springs, Costilla Hot Springs, Thistle Hot Springs, an area in Goshen Valley and two areas along the Utah Lake Fault zone, have water temperatures between 20° and 50° C. Chemical composition of the water suggests that it is meteoric water heated by deep circulation, rising to the surface along fault zones, and mixing with near-surface water.

R.I. No. 192 - *Evaluation of low-temperature geothermal potential of North Central Box Elder County, Utah*, by Mathew C. Davis and Peter T. Kolesar, 1984. 92 pages, tables, plates.

Two areas with low-temperature geothermal potential were located in north central Box Elder County by chemical, temperature, and temperature-depth surveys of wells and springs in the area. Total dissolved solids in the warm water occurrences (29° - 31° C.) ranged from 294 to 11, 590 mg/liter, with high sodium chloride content. Reservoir temperatures, calculated by silica and sodium-potassium-calcium geothermometers, range from 50° to 100° C., and may be as high as 198° C.

R.I. No. 193 - *Summary of low-temperature geothermal studies conducted by the Utah Geological and Mineral Survey from July 1, 1977 to December 31, 1984*, by Robert H. Klauk, 1984, 16 pages, figures.

Seven hot springs in Utah near metropolitan areas were studied for their geothermal potential for home and industrial use, to provide a data base for potential users and a model for studying other geothermal systems. Udy, Crystal (Madsen), Utah, Little Mountain, Warm Springs, Crystal, and Midway Hot Springs areas were investigated with gravity and aeromagnetic surveys and modelling, shallow groundwater temperature surveys, chemical sampling and analysis, gradient hole drilling, and production hole drilling. All except Midway appear to be deep convection systems in a high heat-flow area.

Note: Copies of these reports will be available from National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161. Other geothermal reports of investigation prepared by the UGMS include: R.I.-139, *Geothermal investigations at Crystal Hot Springs, Salt Lake County, Utah*, by Peter Murphy and J. Wallace Gwynn, 1979, 86 p., illustrations and maps; R.I.-140, *Geothermal investigations of the Warm Springs Fault Geothermal System, Salt Lake County, Utah*, by Peter Murphy and J. Wallace Gwynn, 1979, 29 p.; illustrations and maps; R.I.-141, *Geothermal investigations at selected thermal systems of the Northern Wasatch Front, Weber and Box Elder Counties, Utah*, by Peter Murphy and J. Wallace Gwynn, 1979, 50 pages, illustrations and maps; R.I.-142, Geology, *characteristics and resource potential of the low-temperature geothermal system near Midway, Wasatch County, Utah*, by James F. Kohler, 1979, 45 pages; R.I.-174, *Evaluation of low-temperature geothermal potential in Cache Valley, Utah*, by Janet L. deVries, 1982, 96 p., 2 plates; R.I.-179, *Evaluation of low-temperature geothermal potential in Utah and Goshen Valleys and adjacent areas, Part I, gravity survey*, by Deborah Ann Davis, and Kenneth L. Cook, 1983, 138 pages, 2 plates; R.I.-183, *Geothermal assessment of part of the East Shore area, Davis and Weber Counties, Utah*, by Robert H. Klauk and Cheryl O. Prawl, 1984, 46 pages, 5 plates; R.I.-185, *Low-temperature geothermal assessment of the Jordan Valley, Salt Lake County, Utah*, by Robert H. Klauk, 1984, 160 pages; R.I.-186, *Geothermal assessment of the lower Bear River drainage and northern East Shore groundwater areas, Box Elder County, Utah*, by Robert H. Klauk and Karin E. Budding, 1984, 64 pages.

These reports may be seen in the library at the Utah Geological and Mineral Survey, 606 Black Hawk Way in Salt Lake City.

Map 74, *Geologic Map of Arches National Park and vicinity, Grand County, Utah*, by Hellmut H. Doelling, scale 1:50,000, 26" x 45," March 1985, 5 colors; folded map and booklet; $5.00 over-the-counter.

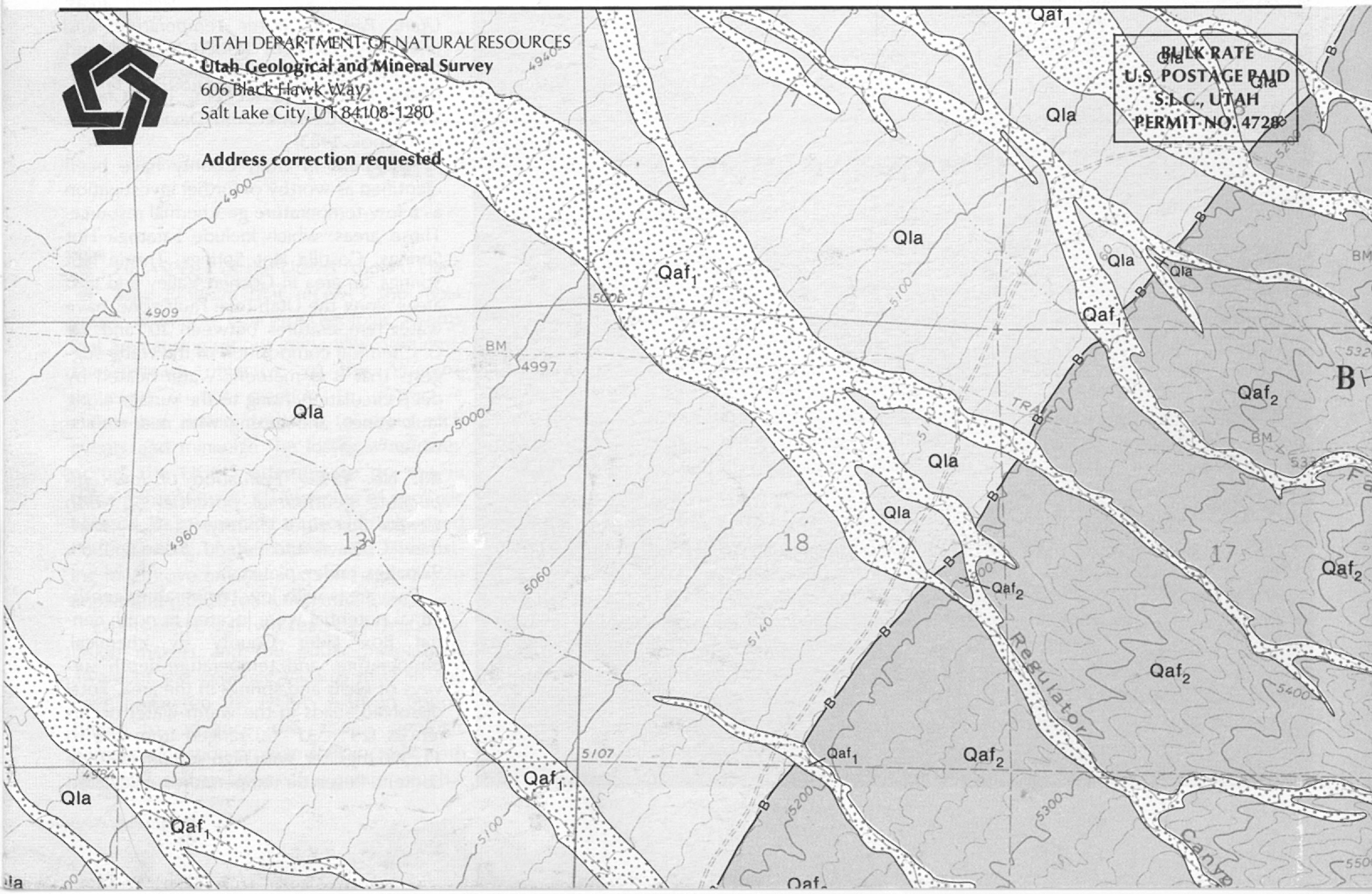
The Utah Geological Association Guide Book No. 13, *Geology of NW Utah, S Idaho and NW Nevada*, is now available. For more information, call Utah Geological and Mineral Survey Sales Office, at 801-581-6831.

All orders must be prepaid. ■

GREAT SALT LAKE LEVEL

Date (1985)	Boat Harbor South Arm (in feet)	Saline North Arm (in feet)
Jan. 1	4208.65	4207.70
Jan. 15	4208.80	4207.90
Feb. 1	4208.90	4207.80
Feb. 15	4209.00	4208.10
March 1	4209.35	4209.15
March 15	4208.30	4208.50

Source: USGS provisional records.



(Seal or Staple Here)

PLACE
STAMP
HERE

Utah Geological and Mineral Survey
606 Black Hawk Way
Salt Lake City, Utah 84108-1280

Attn.: Information Section

Please supply the following information, if applicable:

Principal physiographic provinces of Utah covered by this study:

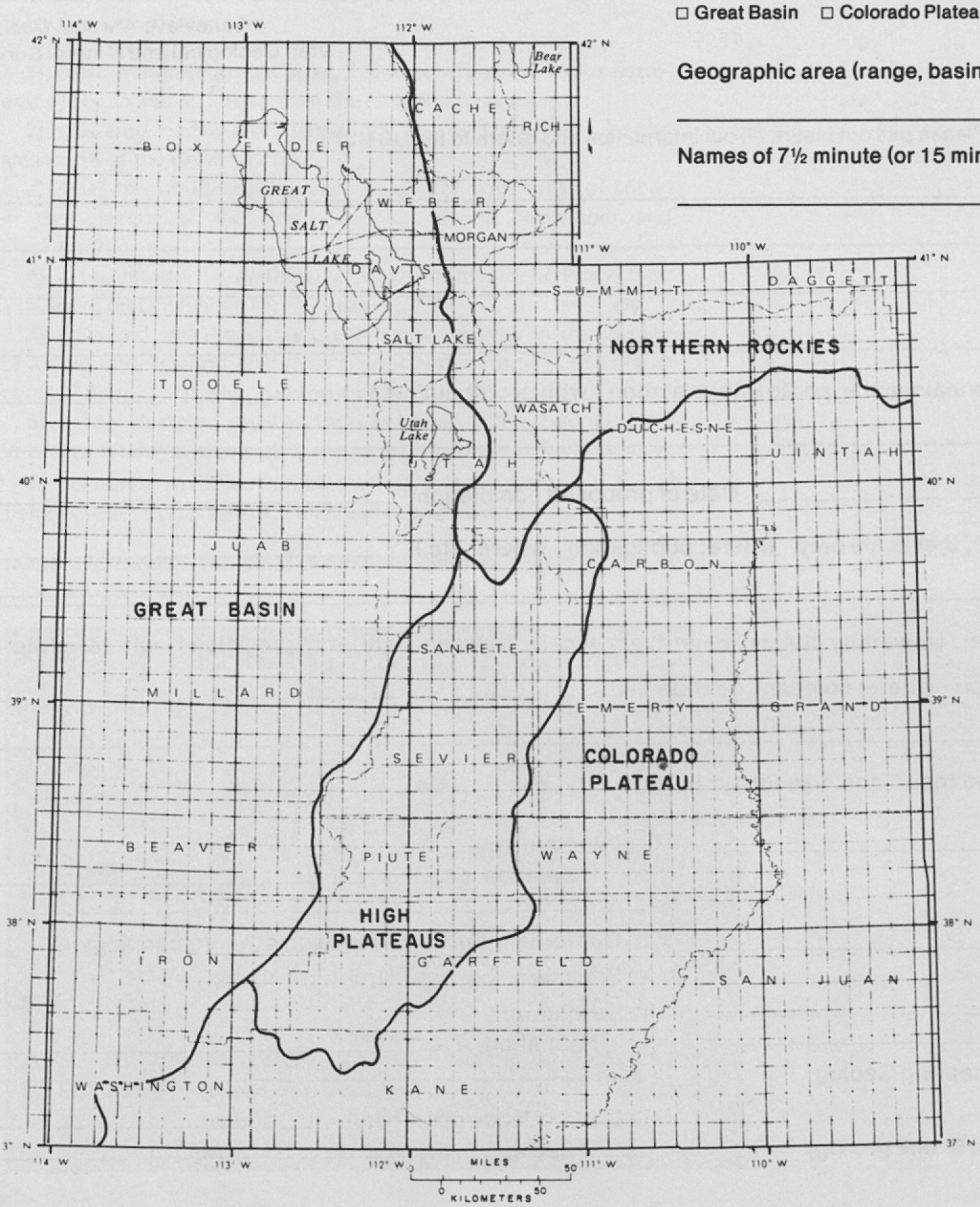
☐ Great Basin ☐ Colorado Plateau ☐ Northern Rockies ☐ High Plateaus

Geographic area (range, basin, etc.): ____________________

____

Names of 7½ minute (or 15 minute) quadrangles: ____________________

____



Which Counties are covered by this study?
(please circle)

All Counties	Morgan
Beaver	Piute
Box Elder	Rich
Cache	Salt Lake
Carbon	San Juan
Davis	Sanpete
Daggett	Sevier
Duchesne	Summit
Emery	Tooele
Garfield	Uintah
Grand	Utah
Iron	Wasatch
Juab	Washington
Kane	Wayne
Millard	Weber

If possible, please fill in location of study area on this map of Utah. Each small square equals one 7½ minute quad.

STATE OF UTAH
NATURAL RESOURCES
Utah Geological & Mineral Survey

Norman H. Bangerter, Governor
Dee C. Hansen, Executive Director
Genevieve Atwood, State Geologist

606 Black Hawk Way · Salt Lake City, UT 84108-1280 · 801-581-6831

Dear Fellow Geologists:

We have many inquiries regarding Utah geology, in areas where published geologic coverage is unavailable or inadequate, and where unpublished field mapping or other geologic studies have been done, are being done, or are planned. Therefore, the Utah Geological and Mineral Survey is soliciting your cooperation for our computerized listing of those areas in Utah being studied by geoscientists in your university or agency.

Please circulate this form among your staff for the required information, and return the information as soon as possible. On the map on the reverse side of this page, indicate the quadrangles covered (or to be covered). More copies are available on request.

If you know of any other universities or organizations who are doing geological work in Utah, please send us their names.

To assist those doing geological work in Utah, the Utah Geological and Mineral Survey has compiled a bibliography of the Geology of Utah on computer. Special searches can be made by quadrangle, formation, commodity, type of study, etc. Please write for more information.

Many thanks for filling out this form. The results of the 1984 survey are printed in the Spring, 1985 issue of our Survey Notes. A copy can be obtained by request at no charge.

Genevieve Atwood

Genevieve Atwood, *Director*
Utah Geological and Mineral Survey

(Please pull out insert, fill out information and return to the UGMS)

Chief Investigator/Geologist: ______

Organization/School: ______

Address: ______
City ______ State ______ Zip ______

Title/Subject: ______

Scope and class (i.e., detailed, reconnaissance, photo interpretation - with or without field checking, etc.): ______

Date of inception: ______ Date of proposed completion: ______

Probable location of information (i.e., thesis file only - where; publication - where; etc.): ______

Probable status on completion (i.e., University thesis; open-file - where; release date and provisions, where; state or technical agency - where; publication - where; company confidential.): ______

May we have a copy of the completed report and map for our library? ☐ Yes ☐ No

What type of study? ______

PK ☐ Paleontology
Formation, age: ______

MP ☐ Geologic Mapping
Scale of map: ______

EC ☐ Economic Geology
Commodities: ______

QS ☐ Quaternary Soils PT ☐ Petrology VC(?) ☐ Volcanology

SD ☐ Sedimentology ST ☐ Structural geology

SR ☐ Stratigraphy
Formation, Age: ______

EV ☐ Environmental Geology EG ☐ Engineering Geology

GC ☐ Geochemistry GP ☐ Geophysics

☐ Other (please specify): ______

HY ☐ Hydrology MN ☐ Mineralogy ~~☐ Hard rock geology~~